

We claim:

1. A process for capturing helium from a helium-containing reject gas stream at a gas processing plant, comprising the following steps:

- (a) providing a membrane unit having a feed side and a permeate side and containing a membrane selective for helium over nitrogen and helium over methane;
- (b) passing the reject gas stream as a feed stream across the feed side under conditions in which transmembrane permeation occurs;
- (c) withdrawing from the feed side as a residue stream a treated reject gas stream depleted in helium compared with the feed stream;
- (d) withdrawing from the permeate side as a permeate stream a gas mixture enriched in helium compared with the feed stream;
- (e) disposing of the treated reject gas stream by a method selected from the group consisting of (i) venting, (ii) flaring, (iii) reinjecting, (iv) using as fuel gas and (v) using as purge gas;
- (f) disposing of the gas mixture by a method selected from the group consisting of (i) storage, (ii) transport to a helium separation facility, (iii) sale and (iv) return for additional processing within the gas processing plant.

2. The process of claim 1, wherein the reject gas stream comprises helium and nitrogen.

3. The process of claim 1, wherein the reject gas stream comprises helium, nitrogen and methane.

4. The process of claim 1, wherein the reject gas stream comprises helium, methane, carbon dioxide and water vapor.

5. The process of claim 1, wherein the reject gas stream contains less than about 10% helium.

6. The process of claim 1, wherein the reject gas stream is a fuel gas stream.

7. The process of claim 1, wherein the reject gas stream is to be used as a purge gas stream for an operation in the gas processing plant.

8. The process of claim 1, wherein the reject gas stream is a vent gas stream.

9. The process of claim 1, wherein the membrane is operated at a stage-cut of at least about 30%.

10. The process of claim 1, wherein the membrane is operated at a pressure ratio of at least about

- 10.
11. The process of claim 1, wherein the permeate stream has a helium concentration of at least about 10%.
12. The process of claim 1, wherein at least about 50% of helium contained in the feed stream is captured into the permeate stream.
13. The process of claim 1, wherein the membrane has a selective layer made from a polymer selected from the group consisting of fluorinated dioxoles, fluorinated dioxolanes and fluorinated cyclically polymerizable alkyl ethers.
14. The process of claim 1, wherein the treated reject gas stream is vented.
15. The process of claim 1, wherein the treated reject gas stream is flared.
16. The process of claim 1, wherein the treated reject gas stream is reinjected.
17. The process of claim 1, wherein the treated reject gas stream is used as fuel gas for a piece of equipment selected from the group consisting of engines, turbines, boilers, reboilers and fuel cells.
18. The process of claim 1, wherein the treated reject gas stream is used as purge gas.
19. The process of claim 1, wherein the gas mixture is sold as crude helium.
20. The process of claim 1, wherein the gas mixture is stored.
21. The process of claim 1, wherein the gas mixture is transported to a helium separation facility.
22. The process of claim 1, wherein the gas mixture is returned for additional processing within the gas processing plant.
23. The process of claim 1, further comprising passing the residue stream to a second membrane separation step that produces a second residue stream, so that the second residue stream becomes the treated reject gas stream.
24. The process of claim 1, further comprising passing the permeate stream to a second membrane separation stage that produces a second permeate stream, so that the second permeate stream becomes the gas mixture.

25. A process for capturing helium from a helium-containing vent gas stream at a gas processing plant, comprising the following steps:

- (a) providing a membrane unit having a feed side and a permeate side and containing a membrane selective for helium over nitrogen and helium over methane;
- (b) passing at least a portion of the vent gas stream as a feed stream across the feed side under conditions in which transmembrane permeation occurs;
- (c) withdrawing from the feed side as a residue stream a treated vent gas stream depleted in helium compared with the feed stream;
- (d) withdrawing from the permeate side as a permeate stream a gas mixture enriched in helium compared with the feed stream;
- (e) venting the residue stream.

26. The process of claim 25, wherein the vent gas stream comprises helium and nitrogen.

27. The process of claim 25, wherein the vent gas stream contains less than about 10% helium.

28. The process of claim 25, wherein the membrane is operated at a stage-cut of at least about 30%.

29. The process of claim 25, wherein the membrane is operated at a pressure ratio of at least about 10.

30. The process of claim 25, wherein the permeate stream has a helium concentration at least about 10%.

31. The process of claim 25, wherein at least about 50% of helium contained in the feed stream is captured into the permeate stream.

32. The process of claim 25, wherein the gas mixture is stored.

33. The process of claim 25, wherein the gas mixture is transported to a helium separation facility.

34. The process of claim 25, wherein the gas mixture is sold as crude helium.

35. The process of claim 25, further comprising passing the permeate stream to a second membrane separation stage that produces a second permeate stream, so that the second permeate stream becomes the gas mixture.

36. A process for capturing helium from a helium-containing fuel gas stream at a gas processing plant, comprising the following steps:

- (a) providing a membrane unit having a feed side and a permeate side and containing a membrane selective for helium over methane;
- (b) passing at least a portion of the fuel gas stream as a feed stream across the feed side under conditions in which transmembrane permeation occurs;
- (c) withdrawing from the feed side as a residue stream a treated fuel gas stream depleted in helium compared with the feed stream;
- (d) withdrawing from the permeate side as a permeate stream a gas mixture enriched in helium compared with the feed stream;
- (e) burning the residue stream as fuel.

37. The process of claim 36, wherein the fuel gas stream comprises helium and methane.

38. The process of claim 36, wherein the fuel gas stream contains less than about 10% helium.

39. The process of claim 36, wherein the membrane is operated at a stage-cut of at least about 30%.

40. The process of claim 36, wherein the membrane is operated at a pressure ratio of at least about 10.

41. The process of claim 36, wherein at least about 50% of helium contained in the feed stream is captured into the permeate stream.

42. The process of claim 36, further comprising disposing of the gas mixture by a method selected from the group consisting of (i) storage, (ii) transport to a helium separation facility, (iii) sale and (iv) return for processing within the gas processing plant.

43. The process of claim 36, further comprising passing the permeate stream to a second membrane separation stage that produces a second permeate stream, so that the second permeate stream becomes the gas mixture.

44. The process of claim 36, wherein the permeate stream has a helium concentration of at least about 10%.

45. The process of claim 36, wherein the membrane has a selective layer made from a polymer selected from the group consisting of fluorinated dioxoles, fluorinated dioxolanes and fluorinated

cyclically polymerizable alkyl ethers.

46. A process for capturing helium from a helium-containing purge gas stream at a gas processing plant, comprising the following steps:

- (a) providing a membrane unit having a feed side and a permeate side and containing a membrane selective for helium over nitrogen and helium over methane;
- (b) passing at least a portion of the purge gas stream as a feed stream across the feed side under conditions in which transmembrane permeation occurs;
- (c) withdrawing from the feed side as a residue stream a treated purge gas stream depleted in helium compared with the feed stream;
- (d) withdrawing from the permeate side as a permeate stream a gas mixture enriched in helium compared with the feed stream;
- (e) using the treated purge gas stream as a purge stream within the gas processing plant.

47. The process of claim 46, wherein the purge gas stream comprises helium and nitrogen.

48. The process of claim 46, wherein the purge gas stream contains at least about 50% helium.

49. The process of claim 46, wherein the purge gas stream contains less than about 10% helium.

50. The process of claim 46, wherein the membrane is operated at a stage-cut of at least about 30%.

51. The process of claim 46, wherein the membrane is operated at a pressure ratio of at least about 10.

52. The process of claim 46, wherein the permeate stream has a helium concentration of at least about 10%.

53. The process of claim 46, wherein at least about 50% of helium contained in the feed stream is captured into the permeate stream.

54. The process of claim 46, further comprising returning the permeate within the gas processing plant.

55. The process of claim 46, wherein the treated purge stream is used as an insulating gas.

56. The process of claim 46, wherein the treated purge stream is used as a blanketing gas.